

Progress Report
Pacific Islands Regional Integrated Ocean Observing System (Pacific IOOS)

Submitted by
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1.0 Progress on Regional Association Development

The period from February 2004 to March 2005 saw a renaissance of planning for a possible Pacific IOOS regional program and the Regional Association that would support such a program. Eileen Shea of the East-West Center agreed to assume leadership as a Principal Investigator for this regional planning effort in February 2004 and began discussions with likely Pacific IOOS partners with an initial focus on the development of a Pacific IOOS proposal to be submitted to the NOAA Coastal Services Center in response to their FY 2005 announcement of opportunity. A proposal was submitted in September 2004 and then revised and re-submitted in November in response to the NOAA/CSC amendment to the call for proposals that revised the level of funding that could be requested and extended the deadline for submission to December 1, 2004. Although formal establishment of a Pacific Regional IOOS/GCOOS program and governance structure is still pending, a number of recent programs and activities have provided insights into information needs and priorities that are helping guide the emergence of a Pacific IOOS program:

- An ongoing effort to update an initial inventory of current ocean observing systems and programs in the region that was originally put together by Roger Lukas and Mark Merrifield (UH-SOEST) in 2003. Initial responsibility for updating the inventory was undertaken in the context of the development of the Pacific Risk Management 'Ohana (PRiMO); the Coastal Ocean Observations and Processes *hui* (working group) of PRiMO is playing a central role in securing input on Pacific IOOS priorities, particularly as they relate to natural and human-induced hazards mitigation. In early March 2005, PRiMO considerations of Pacific IOOS needs and opportunities in the context of risk management were confirmed and will now be considered in the context of a new Observations and Data Management *hui* (working group);
- Ongoing planning for a Pacific Regional contribution to the Global Ocean Observing System (Pacific-GOOS) being coordinated by the South Pacific Applied Geosciences Program (SOPAC) including a week-long series of discussions with Pacific IOOS partners during a visit to Honolulu by Sarah Grimes (Pacific GOOS Program Manager) and Bill Erb (IOC) during December 2004;
- Continued participation of the Pacific IOOS Principal Investigator as a member of the Regional Committee responsible for guidance on the design and implementation of a Pacific Island Global Climate Observing System (PI-GCOS)

program under the auspices of the South Pacific Regional Environment Programme (SPREP);

- Ongoing discussions with University of Hawaii scientists, private sector firms and Federal agencies to further define and develop their interest in and potential contributions to a Pacific Regional IOOS/GCOOS program;
- A June 2004 East-West Center workshop conducted as part of a review of the first decade of operations of the Pacific ENSO Applications Center (PEAC) and the implications of that experience for climate services (including observations and forecasting) and applications in the Pacific;
- An IOOS/Pacific data management workshop held in June 2004 at the All Islands Coastal Zone Conference in Saipan, Commonwealth of the Northern Mariana Islands. This Workshop provided a targeted opportunity to query coastal zone managers regarding their overarching goals for the establishment of a Pacific Region IOOS/GCOOS program and identify the most critical information needs that should be addressed by such a program (a copy of the Pacific IOOS-related Resolution passed by the All Islands Coastal Zone Managers Group is attached to this proposal); and
- The work of a NOAA task force charged with development of a report to Congress on Pacific regional ocean and environmental data and information needs as requested by the Senate as part of NOAA's FY 2004 appropriations and subsequent regional planning for a NOAA Integrated Environmental Applications and Information Center which, among other things, is expected to help support data management aspects of a Pacific IOOS program including DMAC requirements.

In mid-March 2005, the Principal Investigator received notification of NOAA/CSC's intent to recommend approval of funding for the Pacific IOOS program and submitted a revised proposal in response to specific issues raised during the review process. NOAA/CSC has indicated that the likely start date for a Pacific IOOS program would be June 1, 2004.

As described in the Pacific IOOS proposal to NOAA/CSC, activities during the coming year will address the following objectives associated with the emergence of an effective Pacific IOOS regional program:

- **Ensure broad engagement of key stakeholders and partner institutions** in the development of an initial Pacific IOOS program with continuing efforts to assess progress, address problems and explore new opportunities;
- **Identify critical information needs** in the high-priority areas described above including completion of an inventory of existing observing systems and information products, the identification of critical gaps and the development of recommendations for new or enhanced ocean information products; and
- **Establish appropriate program oversight, coordination and implementation mechanisms** to support a Pacific IOOS regional program.

The following list of key milestones provides a summary of specific *tasks to be undertaken in the first year of the pending Pacific IOOS grant in the context of governance options, stakeholder engagement, DMAC and education and outreach*:

- Establishment of interim Pacific IOOS partnership
- Establishment of interim steering committee for Pacific IOOS
- Engagement of new Pacific IOOS partners
- Initial meetings with representatives of key sectors to identify information needs and explore interest in participation in Pacific IOOS
- Complete initial meetings with partners and stakeholders in American Flag Pacific Islands and U.S.-Affiliated Pacific Islands
- Establish Pacific Island IOOS liaisons in American Flag Pacific Islands and U.S.-Affiliated Pacific Islands
- Establish initial Pacific IOOS product teams for the three priority themes (climate, risk management and marine and coastal resources)
- Complete inventory and status assessment of *initial* Pacific IOOS component systems in each of these three priority theme areas
- Continue discussions with NOAA regarding the role of the new NOAA Integrated Environmental Applications and Information Center as a core partner in the Pacific IOOS program and in assisting the program in meeting DMAC requirements
- Establish Pacific IOOS website
- Work with interested Pacific IOOS partners to secure resources (human or financial or both) to support organization of an education and outreach working group to develop recommendations for an initial Pacific IOOS education and outreach program
- Complete analysis of governance options
- Complete initial program outline for Pacific IOOS
- Convene Regional Stakeholder Workshop (spring 2006).

2. Priorities for Observations from a Regional Perspective

Top Priorities for Developing the National Backbone and Pacific IOOS Regional Program

First of all, I would like to reiterate the three priorities identified during the August 2004 Annual Implementation meeting:

- (1) **Fund Regional Associations and the National Federation of Regional Associations sufficiently** to support the appropriate level of outreach, stakeholder engagement and user needs assessment required to fully articulate the requirements of regional IOOS efforts (minimal annual RA support estimated at \$500K each for 11 regions during the three-year initial planning phase; NFRA annual support estimated at \$500K);
- (2) **Fund Necessary DMAC Activities** at the levels identified in the context of the national DMAC planning/implementation effort and provide modest funding to allow initial integration of extant regional systems and to incorporate results of national DMAC activities at the regional level (this latter item estimated at approximately \$200K/region in FY06); and
- (3) **Provide funding for Initial Regional Pilot Projects** as mechanisms to entrain private sector data users and data product suppliers, identify and address issues of data integration and sharing, provide opportunities to showcase successes, and build regional and national constituencies and develop new technology and tools to support the IOOS enterprise.

These priorities remain valid and should be addressed as the highest priorities in FY 2006 and 2007 while developing plans and initiatives for long-term, sustained funding of both the National Backbone and Regional Programs components of IOOS.

In the context of DMAC, the Pacific IOOS team has identified *continued development and support for the new NOAA Integrated Environmental Applications and Information Center in Hawaii* as a high priority to address both regional and national DMAC requirements and activities in support of IOOS.

In addition, the Pacific IOOS team believes that *one of the highest priorities for FY07 and beyond is the explicit identification of sufficient funding for the Regional Program component of IOOS* as well as National Backbone funding priorities in Agency budget requests to Congress. This includes, as a high priority, securing the legislative and executive branch authorities to move from the current funding situation to a truly national program with sufficient funding for full national coverage in both planning AND implementation of regional IOOS programs.

Since the Pacific IOOS program has not yet been formally established, there are no significant changes to the Statement of Initial Priorities that were submitted to Ocean.US in September 2004 (copy attached to this Progress Report for easy reference). Specific

priorities for both the National Backbone and Regional Program will be developed over the coming three years in consultation with Pacific IOOS partners and stakeholders as described in the Pacific IOOS proposal to NOAA/CSC.

Earlier this year, the *National Data Buoy Center* requested input from Regional Associations requesting input on our priorities in the context of their plans to accelerate addition of Acoustic Doppler Current Profiler (ADCP) and surface salinity measurements to NDBC buoys and coastal marine stations. *The Pacific IOOS team identified the following priorities that I am reiterating here in the context of National Backbone priorities in the near-term:*

- A high priority for Hawaii is directional wave information from Buoy 51001 (200 NW of Kauai) and a new buoy at 24.0N 156.4W to get information on waves coming in from the NE. TPC included the new buoy listed above at 24.0N 156.4W as priority 10 out of the 51 forwarded to NDBC;
- Equally important would be directional capability for Buoy 2 south of Hawaii in order to address winter swells out of the west from the fetch south of Japan. Many of the harbor entrances around the state have southerly exposure. Having directional information from the south will support more specific harbor entrance warnings, and will allow boaters to redirect to safer harbors;
- In the draft NOAA Pacific Island Region Data Management Report, Improving Weather and Water Information Forecasting and Warning, Unmet Information Requirements, Data Coverage, second paragraph, describes a January 2004 study done by Chip Guard (National Weather Service, Guam Forecast Office) that identified needs for 16 ocean sites for the Northwest Pacific and 2-4 ocean buoys for American Samoa. These additional buoys are required because there are currently very few observing sites in the large coverage area incorporated into American Samoa. These additional buoys should be positioned to detect shifts in the South Pacific Convergence Zone (SPCZ), which affects weather conditions in American Samoa.

3.0 Issues, Challenges and Opportunities

- In the Pacific, we have recently identified exciting opportunities to link Pacific IOOS ocean ecosystem observing and data management activities with similar observational and data management interests of the *NEON program* that focuses on long-term observations of terrestrial ecosystems. The Hawaiian resource management concept of ahupua'a – from the mountain ridge to the outer edge of the coral reef – acknowledges the importance of addressing resource management and ecosystem health issues in an integrated fashion in the coastal zone. Although discussions are only preliminary, the Pacific IOOS team and local Pacific NEON project scientists have agreed to work closely together and look for specific opportunities to undertake collaborative work and more closely integrate

our plans for regional observing systems. One specific area of shared interest is in meeting the data integration and visualization challenges that both programs face and we are considering the possibility of joint planning workshop on that subject in early 2006. It would be interesting to know if other IOOS regional groups are seeing similar opportunities for collaboration with emerging NEON programs in their regions.

- The Pacific IOOS team is also exploring a close linkage with the Pacific *Regional Integrated Science and Assessment (RISA) program* run by NOAA's Office of Global Programs in the context of addressing climate-related aspects of Pacific IOOS. Both programs are focused on developing and delivering useful and usable information products to support decision-making and the Pacific RISA program has laid some substantial groundwork in the area of stakeholder engagement in sectors, agencies, businesses and communities addressing climate-related challenges and opportunities. Again, there might be similar opportunities in other regions with both Regional IOOS and RISA programs and it would be interesting to hear from others who might have already established similar relationships.
- The Pacific IOOS team continues to be concerned with the current mismatch between the timelines for national-level planning, program development and documentation activities organized by Ocean.US and the planning and program development timelines for development of effective regional programs. This is particularly critical in the context of ensuring that our efforts in stakeholder engagement are effective and legitimate – in both reality and in perception. Both the providers and users of IOOS information products should be fully engaged in the identification of critical information needs and the design, development and evaluation of IOOS products. The individual Regional Associations are trying to do that and our regional programs and plans acknowledge that this process of engagement takes time as well as significant human resources. The Pacific IOOS team continues to be concerned about the apparent “rush” to document – and annually update – consensus statements on priorities and define needs before many of us have even begun our regional planning process. On a personal note, having served in a Federal agency program office for nearly 20 years, I understand the need for and opportunities associated with being asked to provide input to budget planning and development. At some stage, however, we need to step back and acknowledge that the regions need the time and resources necessary to fully engage our partners and TOGETHER identify information needs, priorities and program plans so that our input to national-level planning will truly reflect regional interests and partners.
- A related issue relates to the need to recognize that “one size does not fit all” when it comes to the individual approaches that regions will take in addressing specific components of their IOOS programs. This issue first surfaced for the Pacific IOOS team about a year ago when we participated in discussions of governance structure and which re-surfaced again recently in discussions of

mechanisms for stakeholder engagement and education advisory mechanisms. We in the Pacific region believe that Ocean.US, the Federal agencies and the regions have made progress toward recognizing the need to embrace guidelines without mandating mechanisms **but** we also think that we need to remain vigilant in our efforts to ensure that regional IOOS programs are allowed to evolve in ways that are appropriate to the environment, culture and capabilities of each region.

- Consistent with last year's RA consensus on the need to fully fund regional planning activities at funding levels greater than are currently available, the Pacific IOOS team would like to draw attention to the increasing demands for time, people and money to contribute to a variety of implementation activities at the national level such as the IOOS demonstration project, DMAC, national-level education planning, etc. These activities are placing increasing demands on already over-constrained Regional budgets and personnel.
- Finally – but perhaps most importantly – we must ensure that Federal agencies, programs and offices interested in being partners in regional IOOS programs are allowed to do so. Full participation of local Federal partners is essential to the ultimate success of the Pacific IOOS regional program, for example, and we suspect that the same is true for many if not all of the other regions. This should not be a question of IF but a question of HOW.

Attachment
Initial Priorities for Regional Coastal Ocean Observing Systems
National Backbone and Regional Program
Initial Input from Pacific Islands Region

Submitted on behalf of the Pacific Region by:
Eileen L. Shea, East-West Center
Chris Chung, HI Coastal Zone Management Program
Serving as Interim Co-Directors of a Pacific GCOOS Regional Association

Forward

The following initial statement of priorities reflects an attempt to synthesize insights and recommendations that have emerged from a variety of meetings, workshops and program planning efforts over the past few years. Some of the more recent activities involved explicit discussions of a Pacific Regional IOOS/GCOOS program but many were focused on programs or problems that form one or more of the seven societal goal areas for IOOS (e.g., discussion of adaptation to climate variability and change). A focused effort to define, develop and implement a Pacific Regional IOOS/GCOOS Program has just begun in earnest this year so what follows are clearly only some preliminary insights to help guide us – and IOOS more generally – as we begin our journey toward a regional program that effectively integrates information about changing ocean conditions into community planning, resource management and sustainable development for Pacific Islands.

Background

Planning for a Pacific Regional GCOOS activity as a contribution to the Integrated Ocean Observing System (IOOS) program began in earnest in late 2003 although preliminary efforts to define regional needs and secure initial resources to support the development of a Pacific program had begun a year earlier through the efforts of Roger Lukas, Mark Merrifield and colleagues at the University of Hawaii School of Ocean and Earth Sciences and Technology (UH-SOEST). While targeted resources to support the emergence of a Pacific GCOOS regional program have not yet become available, a Pacific GCOOS team participated in the March 2004 IOOS/GCOOS meeting in Washington, DC and renewed efforts to coordinate the development of a Pacific regional IOOS/GCOOS program¹. While the national IOOS program has a U.S. focus, the Pacific regional IOOS program will be developed in the context of broader, regional observing system (e.g., PI-GOOS and PI-GCOS) and environmental information and service programs.

¹ For purposes of a regional IOOS/GCOOS program, the Pacific region is defined to include the American Flag Pacific Islands, comprising the State of Hawaii, Guam, American Samoa and the Commonwealth of the Northern Mariana Islands, as well as the U.S.-affiliated Pacific Islands which include the Federated States of Micronesia, the Republic of Palau and the Republic of the Marshall Islands.

At the moment, the embryonic Pacific IOOS/GCOOS team is being coordinated by Eileen Shea (East-West Center) and Chris Chung (Director, HI Coastal Zone Management Program) with significant contributions from the NOAA Pacific Services Center and with participation from the East-West Center; the Hawaii State Department of Business, Economic Development and Tourism (DBEDT), most notably the HI Coastal Zone Management Program; the All Islands Coastal Zone Managers Group; the University of Hawaii, including the School of Ocean and Earth Sciences and Technology, the International Pacific Research Center, the HI Sea Grant Program, the Hawaii Institute of Marine Biology, and the Social Science Research Institute; and a number of Federal agencies including NOAA, the U.S. Army Corps of Engineers and several other Federal and state agencies participating in an ocean observations hui (working group) of a new Pacific Risk Management Ohana (PRiMO) organized by the NOAA Pacific Services Center to enhance coordination among government agencies and scientific institutions engaged in risk management activities in the Pacific. Efforts are underway to expand this Pacific regional IOOS/GCOOS team to include other state and Federal agencies, scientific and educational institutions, government agencies, NGOs and private sector stakeholders in all of the jurisdictions that will be covered by the program.

Initial Priorities

Although formal establishment of a Pacific Regional IOOS/GCOOS program and governance structure is still at a preliminary stage, a number of recent programs and activities have provided insights into information needs and priorities that might help guide the emergence of a Pacific regional program. Involving both scientists and stakeholders, these recent activities include:

- Ongoing ocean observations, modeling, research, forecasting, assessment and information management programs in the Pacific being undertaken in Federal, state and local agencies, the University of Hawaii and a number of other scientific institutions throughout the Pacific. An initial inventory of these programs at the University of Hawaii was completed by UH-SOEST scientists in 2003 and helped inform the initial efforts by UH-SOEST scientists to submit initial proposals for support for regional IOOS/GCOOS planning and implementation in the Pacific;
- An initial Assessment of the Consequences of Climate Variability and Change for Pacific Islands which began in March 1998 and concluded with the issuance of a final report in November 2000 as well as ongoing follow-up workshops and briefings designed to explore climate-related challenges and opportunities in the American Flag and U.S.-Affiliated Pacific Islands;
- Ongoing planning for a Pacific Regional contribution to the Global Ocean Observing System (Pacific-GOOS) being coordinated by the South Pacific Applied Geosciences Program (SOPAC);
- An October 2002 Workshop on the Potential Applications of Ocean Observations for Pacific Islands held in Suva, Fiji under the auspices of SOPAC and NOAA

and efforts by the University of Hawaii and the East-West Center to develop a 2003 proposal to the National Ocean Partnership Program (NOPP) to implement some of the key findings and recommendations from the October 2002 Suva workshop;

- The design and implementation of a Pacific Island Global Climate Observing System (PI-GCOS) program under the auspices of the South Pacific Regional Environment Programme (SPREP) which began with an August 2000 Workshop in Apia, Samoa and continued through publication of the PI-GCOS Action Plan in March 2002 and an initial implementation plan in 2003;
- Discussions of ocean observations and processes in the context of an emerging Pacific Risk Management Ohana (PRiMO) which has emerged from two years of meetings of Federal and state agencies engaged in hazards mitigation in the Pacific; the ocean observations and processes hui (working group) of PRIMO is playing a central role in securing input on IOOS/GCOOS priorities in the Pacific, particularly as they relate to public safety and health;
- A March 2003 meeting of University of Hawaii scientists to discuss the University's interest in and potential contributions to a Pacific Regional IOOS/GCOOS program;
- A June 2004 East-West Center workshop conducted as part of a review of the first decade of operations of the Pacific ENSO Applications Center (PEAC) and the implications of that experience for climate services (including observations and forecasting) and applications in the Pacific;
- An IOOS/Pacific data management workshop held in June 2004 at the All Islands Coastal Zone Managers Conference in Saipan, Commonwealth of the Northern Mariana Islands. This Workshop provided a targeted opportunity to query coastal zone managers regarding their overarching goals for the establishment of a Pacific Region IOOS/GCOOS program and identify the most critical information needs that should be addressed by such a program; and
- The initial report of a NOAA task force charged with development of a report to Congress on Pacific regional ocean and environmental data and information needs as requested by the Senate as part of NOAA's FY 2004 appropriations.

The reports, findings and recommendations from these activities have helped inform this *initial* statement of priorities for a Pacific Regional IOOS/GCOOS program as requested by Ocean.US. Discussions with interested scientific partners and stakeholders are ongoing and will help refine and strengthen our understanding of critical information needs and priorities in and for the Pacific.

National Backbone Priorities

Underpinning all discussions of ocean observing system priorities in the Pacific is a call for the establishment of an *end-to-end system* that:

- Effectively integrates observations, research, integrated modeling, forecasting, assessment, information management and education; and
- Involves a true partnership among the providers of information on ocean conditions and the users of that information in government, resource management, community planning, business and science.

This means that we must be as concerned with providing the necessary communications, data and information management infrastructure as we are with any proposed expansion/enhancement of a suite of observational platforms and we must **ensure that observational programs support not only data collection but also the analysis and interpretation necessary to convert observations into useful and usable information.** In this context, the Pacific joins other regional IOOS/GCOOS teams in calling for **enhanced support for integrated modeling** as a high-priority component of the National Backbone for IOOS/GCOOS as well as in planning for a regional program.

One of the highest priorities for the IOOS/GCOOS National Backbone activities should be the establishment of effective national and regional data and information management capabilities that provides easy, user-friendly access to regional, national and international data sets and supports the production of regionally-relevant information products from the ocean observing system platforms and programs that comprise the National Backbone. For the Pacific, this requirement includes support for **enhancements to communications systems necessary to relay information to and from remote locations, the establishment of regional data management nodes to facilitate access to and local interpretation of ocean observations in the numerous jurisdictions represented in the Pacific region and the establishment of a Pacific ocean and environment information center** such as the one currently being considered by NOAA and its partners in the region. While some of the responsibilities for an effective Pacific regional IOOS/GCOOS data and information management program will fall to the non-Federal partners in the region, Federal agencies like NOAA, USGS, the Corps of Engineers and others will continue to play central roles and their data management contributions to the National Backbone are as important as their continued support for critical platforms and observational programs.

In addition, for the Pacific, it is important to recognize that **open ocean observations are as important as near-shore observations for the large ocean developing states that populate the Pacific**². Hawaii's Governor, Linda Lingle, highlighted this issue in her response to the initial Oceans Commission report when she noted that

² Arona Ngari from the Cook Islands National Meteorological Service suggested that rather than the traditional nomenclature of Small Island Developing States, Pacific Islands (and other island jurisdictions) are, more correctly, characterized as large ocean developing states where the distinction between open ocean and coastal ocean loses its meaning and the future of economies and communities are dominated by ocean conditions and resources.

“...Hawaii, unlike other coastal states, has a narrow coastal zone that is strongly affected by the surrounding deep ocean environment. Thus Hawaii has a large stake in ensuring that a balance is struck between nearshore research and management needs and research in larger basin-scale environment in which the Hawaiian Archipelago is embedded.”

In this context, for example, a Pacific perspective on a National Backbone for IOOS/GCOOS would include the continuation of ocean-based climate observing systems such as the TOGA-TAO array – and the seasonal climate forecasts which they support – as essential to managing climate risks in the region. Since the Pacific Islands sit in what some have called the “heartbeat of the Earth’s climate system,” **information on the nature and consequences of changing weather and climate conditions** emerges from any discussion of priorities for ocean observations in the Pacific.

As is the case with most of the regional IOOS/GCOOS programs, the Pacific Regional program supports the **continuation and enhancement of current NDBC, NWLON, CMAN and similar buoy programs** that currently provide information on a variety of physical parameters such as sea surface and sub-surface temperature, salinity, wind speed and direction, wave heights and currents. Discussions in the Pacific also suggest that enhancing these programs with **additional observations and modeling programs to secure information on local eddies** would be an important for the region for a variety of purposes. Bathymetric information would, of course, be important for the development of wave forecasts and assessment of current conditions.

In addition to these physical parameters, Pacific region discussions of ocean observations highlight the need for **enhancement of these observational platforms to include chemical and biological parameters that will provide information: on water quality including but not limited to bacterial content and other parameters important to public and ecosystem health; nutrient levels; the role of coastal ecosystems as sources and/or sinks for carbon dioxide including a sustained carbon monitoring program; and habitat type and health.**

In addition to the buoy programs identified in the Ocean.US matrix, discussions of a National Backbone for IOOS/GCOOS in the Pacific suggest **the importance of including long time-series stations like Station Aloha** which builds on 15 years of the Hawaii Ocean Time Series (HOTS) program that combines data from fixed platforms with routine shipboard observations and provides valuable insights into changing physical and chemical ocean conditions in the region.

Discussions of IOOS/GCOOS priorities in the Pacific have also highlighted the importance of including **observational programs designed to monitor the health and status of coastal ecosystems and natural resources including coral reefs and fisheries** (in this latter case involving coastal fish species important for subsistence and cultural purposes as well as commercial fish species). This would suggest that both the National Backbone and regional IOOS/GCOOS program in the Pacific should include consideration of routine biological surveys and ecosystem assessment programs.

Related to coastal ecosystem health is the importance of **including information on rainfall and stream flow** not only as critical input for understanding and managing climate risks but also as critical to providing information on the consequences of sedimentation and non-point source pollution for coastal and near-shore marine ecosystems. Similarly, **observations that improve understanding of coastal erosion and sedimentation patterns and rates** would be important elements of an IOOS/GCOOS National Backbone in the Pacific. Given the close connection between the land and the coastal ocean that characterizes island settings, observations of land use and land cover change that affect rainfall, streamflow and sedimentation would also be important elements of an integrated observing program for the Pacific. In this context, partners in an emerging Pacific IOOS program highlight the importance of addressing the Airlie House recommendation regarding **integrated estimates of annual land-sea freshwater flows and associated fluxes of sediments, nutrients and contaminants** as both a part of the National Backbone and an important priority for a regional program in the Pacific.

Monitoring of water levels – including **measurements of sea level variations and long-term trends** -- is often highlighted in discussions of high-priority ocean observations for Pacific Islands. This would involve both water level monitoring to support continuous monitoring of relative sea level as well as water level and geodetic measurements required to develop long-term trends in absolute sea level. From a Pacific perspective, it is important to note that an effective sea level component of an IOOS program must reflect a commitment to the integration of both satellite and *in situ* measurement systems on a sustained basis. In addition to seasonal-to-interannual variations and long-term trends, there is a need to ensure that a sea level component of IOOS addresses the full spectrum of energetic processes that affect sea level on shorter time and space scales including the development of tailored products such as high-wave event inundation warnings or tsunami warnings).

Although we recognize that the definition of a National Backbone for IOOS has focused primarily on specific observations or observing platforms, discussions of IOOS/GCOOS in the Pacific also point to **three critical areas of investment not currently listed** on the Ocean.US matrix for the National Backbone of an IOOS/GCOOS program:

- **development and testing of new instruments and observational systems (technology development and evaluation).** In this context, for example, discussions in the Pacific have pointed to the potential value of exploring the utility of Automated Underwater Vehicles as a component of a regional IOOS/GCOOS program;
- **investment in education and training** to enhance and sustain the cadre of individuals skilled in both deploying and maintaining observational instruments and platforms as well as in the analysis and interpretation of ocean observations necessary to transform observations into useful and usable information products; and

- **socio-economic research and integrated assessment programs** that would help improve understanding of the international, national, regional and local consequences of changing ocean conditions and, conversely, the impacts of human activities on the coastal ocean environment.

While these program elements are expected to be important components of a regional program, one would also expect to see them as elements of Federal Agency investment in the National Backbone for IOOS/GCOOS as well.

Pacific Regional IOOS/GCOOS Program

All of the information needs and priorities described above for the IOOS/GCOOS National Backbone will also help guide the emergence of a Pacific regional program that advances the use of ocean observations to support decision making by Pacific Island governments, communities, businesses and resource managers. As noted earlier, the initial Pacific Regional IOOS/GCOOS team is facilitating a series of discussions with key partner institutions and stakeholder groups to help develop plans for the evolution of a Pacific Regional Association and the identification of initial priorities for Pacific program. As noted earlier, underpinning these emerging plans is a commitment to an *end-to-end system* that:

- Effectively integrates observations, research, integrated modeling, forecasting, assessment, information management and education; and
- Involves a true partnership among the providers of information on ocean conditions and the users of that information in government, resource management, community planning, business and science.

In this context, we currently envision development of a Pacific Regional IOOS/GCOOS program that includes the following program elements:

- *Enhancements to regional and local observing systems* that supplement the National Backbone and provide locally-relevant observations of changing ocean conditions;
- *Data assimilation, analysis, integrated modeling and assessment activities* to transform ocean observations and research results into useful and usable information products, including the integration of socio-economic and cultural considerations;
- *Data communications and information management activities* to ensure easy, user-friendly access to regional IOOS/GCOOS products;
- *Technology development* including the design and evaluation of new tools and techniques including the implementation of IOOS/GCOOS *observational pilot (demonstration) programs* as appropriate;

- *Education*, including formal training and education to enhance the cadre of individuals skilled in ocean observations and applications as well as informal education and public outreach activities; and
- *Continuous, interactive dialogue with decision makers and other key stakeholders* designed to identify critical information needs, support the development and evaluation of Pacific Regional IOOS/GCOOS products and provide a mechanism for feedback to both the regional and national IOOS program.

While a comprehensive Pacific Regional IOOS/GCOOS program will focus on all seven IOOS goals, initial discussions and planning activities suggest that early priority will be given to:

- **Preserving healthy marine and coastal ecosystems** with an emphasis on information to support effective management of the unique ecosystems and resources that are vital to the livelihood of Pacific Island communities (e.g., coral reefs). This focus will also address the need to support the effective, sustainable management of fisheries, including both commercially-important marine species such as tuna as well as coastal and nearshore fisheries important for subsistence, cultural and commercial purposes;

- **Predicting weather and climate and supporting adaptation to climate variability** and change with implications for: *mitigating climate-related natural hazards* to ensure public safety and protect community infrastructure; *supporting economic development* in critical climate-sensitive sectors such as fisheries, tourism and agriculture; and *ensuring safe navigation and transportation*; and, more broadly,
- **Mitigating hazards** including support for incident response, maritime safety, disaster management related to both natural and human-induced threats and the development of integrated vulnerability assessment and risk management programs.

The Pacific Regional IOOS/GCOOS program will be **problem-focused and reflect a participatory process** involving scientists, educators, communities, resource managers, government officials and other decision makers in the public and private sector. Establishing and sustaining this kind of partnership will require the investment of time, money and human resources in a program of outreach and engagement that reflects a new paradigm in environmental observations, science and services. In the Pacific, for example, we envision the creation of *product teams comprising scientists and users* to help guide the design and evaluation of key IOOS/GCOOS information products. In addition, we anticipate dedicating resources to a continuing program of outreach with key stakeholders and partner institutions to assess progress, address problems and explore new opportunities for what we see as a dynamic, evolutionary Pacific Regional IOOS/GCOOS program.

The rich cultural heritage and diversity of the Pacific Region requires that a Pacific Regional IOOS/GCOOS program **address cultural as well as scientific and socio-economic considerations**. We anticipate including a targeted effort focused on the integration of traditional and local knowledge, practices and methodologies for observing and understanding (knowing) the integrated Pacific ocean-society system. An important element of a technology development program in the Pacific will include **targeted efforts to integrate local knowledge and community-based observations** with technologically-advanced measurement systems.

A Pacific Regional IOOS/GCOOS, for example, will reflect an understanding of the need for an *integrated perspective on the connections between land, coast, ocean and communities*. This whole island perspective is a longstanding characteristic of the region as exemplified, for instance, in the traditional Hawaiian ahupua'a resource management system that recognizes the need for an integrated approach that incorporates considerations from the top of the mountain to the open ocean and employs a participatory resource management approach that involves experts from all walks of life.

A Pacific Regional IOOS/GCOOS will include a program of **education and training** as a critical program element with attention to specialized training to develop and maintain the skilled cadre of individuals who will be responsible for producing and applying the information products derived from a Pacific Regional IOOS/GCOOS program. In

addition, we anticipate a targeted enhancement of formal education programs and opportunities at graduate, undergraduate and K-12 levels. We also anticipate a program of support for informal education and public education programs at the community level through the development of informational materials, the organization of an Pacific Regional IOOS/GCOOS speakers bureau and the organization of periodic public education special events in collaboration with key partners in formal and public education including NGO's; museums, aquaria, parks, marine sanctuaries and other marine protected areas; Sea Grant; Pacific Resources for Education and Learning (PREL); and others.

Concluding Thoughts

A Pacific Regional IOOS/GCOOS program will be developed as an integral component of sustainable development planning within and among the numerous jurisdictions comprising this vast and diverse region. Particular attention will be given to providing information to support critical economic sectors such as agriculture, tourism and fisheries and to managing the natural coastal and marine resources that provide the foundation for those sectors and sustain the communities that call Pacific Islands home. We have only just begun this shared IOOS/GCOOS journey here in the Pacific Region. As was the case with early Polynesian navigators, we anticipate that our journey will be guided by a dynamic and ever-expanding awareness of the intimate partnership between the ocean and the goals and aspirations of Pacific Island communities. We will learn to listen with ears, minds and hearts that remember the lessons of the past and incorporate the old ways with the promise of new tools and technologies. We will remember the need to integrate observations of different environmental conditions into information that supports our decisions throughout the journey. Perhaps most importantly, we will recognize that each of the partners in this journey brings a special expertise and unique talent without which we cannot succeed. The story of this journey will continue and we look forward to sharing it with our regional, national and international IOOS partners in the coming months and years.

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